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2.2 Economic and Environmental Analysis

Decisions to make changes that improve the energy performance or reduce the environmental impacts of a facility require close attention to economics as well as sustainability. Several key methods can be used for conducting economic analyses to support these decisions. The most important economic analysis method for Federal facility managers and designers, and required by 10 CFR 436, is *Life-Cycle Costing (LCC)*, an adaptation of Cost-Benefit Analysis to applications where benefits are primarily cost reductions. The method discounts future cash flows to their present value in order to compare the life-cycle cost of different options. LCC is particularly important in analyzing the economics of decisions regarding buildings, since buildings and their associated components often have long life cycles. As a result, the benefits (or disadvantages) accrue over a long period of time. If the action leads to reduced costs over its lifetime, it can pay back any additional costs required to take the action and then save money over the long term. Many energy efficiency and water conservation measures might appear to "cost more" than their alternatives if only first costs are considered; through life-cycle costing, these measures often demonstrate that they save money. The regulation 10 CFR 436 requires Federal managers to base decisions on LCC and directs the National Institute of Standards and Technology (NIST) and DOE to provide a standard set of methods and economic parameters such as discount rate.

Technical Information

Life-Cycle Costing analyzes the design of, or changes to, facilities, buildings, or building systems, including initial costs, maintenance costs, repair costs, replacement costs, energy and water costs, and other significant costs over the assumed life of the measure or facility. The method combines all costs into net annual amounts, discounts them, usually to *present value*, and sums them to arrive at total LCC.

Environmental Life-Cycle Assessment (LCA) is used to analyze the potential environmental impacts that are associated with the entire life cycle of a product, from the raw materials to final disposal of the product after its use. This is sometimes called "cradle-to-grave" or "cradle-to-cradle" analysis. It is useful for understanding the advantages and disadvantages of products from an environmental point of view. The strength of LCA is its comprehensive approach; instead of choosing a product based only on its energy efficiency or recycled content, LCA provides information on the full range of environmental attributes. Unlike LCC, which expresses the outcome in a single monetary unit, LCA expresses the results in energy units, mass units of pollutants, potential impacts, and other units. Some LCA practitioners think that a single, simple representation of the outcome, such as a single dollar figure, is not possible.

ECONOMIC ANALYSIS TOOLS

Several readily available tools can be used to perform an economic analysis for use in the decision-making process.

The National Institute of Standards and Technology's Building Life-Cycle Cost (BLCC) computer program provides an economic analysis of proposed capital investments that are expected to reduce long-term operating costs of buildings or building systems. BLCC also calculates annual and life-cycle CO_2, SO_2, and NO_x emissions for building energy systems. BLCC is based on the ASTM standard life-cycle cost approach and is designed to comply with 10 CFR 436.

In addition to comparing two or more alternatives on an LCC basis, BLCC computes the net savings, savings-to-investment ratio, adjusted internal rate of return, and years to payback.

The Society for Environmental Toxicology and Chemistry (SETAC) has published guidelines and resources for environmental LCA. This methodology is widely accepted.

NIST has also developed a computer program for associating economics and selected environmental impacts for building products. Building for Environmental and Economic Sustainability (BEES) synthesizes LCA and LCC measures into an overall performance measure.

LIFE-CYCLE COST ANALYSIS PARAMETERS

- Project Initial Cost
- Annual O&M Costs
- Non-Annually Recurring O&M Costs
- Energy and Water Quantities and Costs
- Salvage Value
- Type of Analysis: Federal, military, private sector
- Treatment of Inflation: constant or current dollars
- Base Date: the date to which all future costs are discounted
- Service Date: the date at which the facility will be occupied or the system put into service
- Study Period: usually the life of the facility or product (40-yr. max. for buildings, 25-yr. max. for mechanical equipment)
- Discount Rate: the investor's opportunity cost, or the minimum acceptable rate-of-return, published annually by NIST
- Energy Cost Escalation Rates: the inflation rates for electricity, gas, oil, coal, and gasoline, published annually by NIST
- Applicable Tax Rates: for private-sector analyses

References

Life-Cycle Costing Manual for the Federal Energy Management Program (NIST Handbook 135) and *Annual Supplement (ASHB) of Energy Price Indices and Discount Factors*. A guide to understanding the LCC methodology and criteria established by FEMP for the economic evaluation of energy and water conservation and renewable energy projects in Federal buildings. Available from the FEMP Help Desk (HB 135) or downloadable from the DOE FEMP Web site (ASHB).

BLCC4 - Building Life-Cycle Cost (BLCC) – Computer Program, User's Guide and Reference Manual, (NIST IR 5185-2). This program is updated annually on April 1 with current FEMP discount rates and DOE energy price escalation forecasts. It is available free of charge from the FEMP Help Desk or can be downloaded from the DOE FEMP Web site.

Three video training films offering an introduction to FEMP life-cycle costing methods are available from Video Transfer Inc.: (1) "An Introduction to Life-Cycle Cost Analysis," (2) "Uncertainty and Risk," and (3) "Choosing Economic Valuation Methods." For ordering information, contact VTI at 5709-B Arundel Ave., Rockville, MD 20852 or at (301) 881-0270.

Training workshops on the life-cycle cost method and the use of BLCC and associated programs are offered in various locations throughout the country. Contact the FEMP Help Desk or go to the FEMP Web site.

Contacts

The FEMP Help Desk at (800) DOE-EREC (363-3732) or FEMP's Web site: www.eren.doe.gov/femp/.

NIST Office of Applied Economics: (301) 975-6132, (301) 975-5337 (fax); www.bfrl.nist.gov/oae.html.

Information about Product Life-Cycle Assessment is available from the Society for Environmental Toxicology and Chemistry, Pensacola, FL; (904) 465-1500; www.setac.org. The SETAC LCA methodology is the most widely accepted procedure for determining the environmental impacts of materials or products.